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OPERATION AND SERVICE MANUAL

for 1974

MODEL 4302A MANUAL CONTROL UNIT

WEINSCHEL ENGINEERING

GAITHERSBURG, MARYLAND

OPERATION AND SERVICE MANUAL

for 1974

MODEL 4302A MANUAL CONTROL UNIT

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Weinschel Engineering
Gaithersburg, Maryland
1974

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ADDENDUM
FOR OPERATING AND SERVICE MANUALS
MODELS 430A, 4310A/K, 4301, 4302, and RF UNITS

CAUTION

Ensure that the fan on the rear of the Model 430A Mainframe is installed and operational when an RF Unit is used. Otherwise, serious damage may occur within the unit.

When a Model 4302 Manual Control Unit is installed in a Model 430A Mainframe, the fan on the rear of the 430A must be removed. The removal of the fan is necessary to gain access to the connectors and terminal board on the rear panel of the 4302.

To remove the fan, proceed with the following steps:

a. Turn off power to the unit.

b. Disconnect fan plug (P14). Accessible either by removing the top cover or removing the plug-in unit.

c. Remove trim on left rear of unit (secured by two Phillips screws) and slide filler strips from side of unit.

d. Remove the two screws and two bolts securing the fan to the unit. Remove fan and retain for future use.

e. Replace, bolts, screws, filler strips and trim.

CAUTION

The fan is not required when a Model 4302 is installed in the mainframe. However, when an RF Unit is installed, the fan must be connected or serious damage to the unit may result.

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SECTION 1

GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This manual contains information necessary for understanding the application and operation of the Model 4302A Manual Control Unit used with the Model 430A Mainframe and the Model 4301A RF Unit Holder. The manual provides a general description, installation information, operating instructions, principles of operation and maintenance information. A complete set of schematic diagrams is also provided to aid in understanding the various modes of operation and proper servicing of the equipment.

1.2 DESCRIPTION

The Model 4302A Manual Control Unit is designed to permit operation of up to six selectable RF Units from a single Model 430A Mainframe. When a particular RF Unit is operating, it will provide the same functions as when it is plugged directly into the Model 430A Mainframe.

Figure 1-1 shows a Model 4302A Manual Control Unit installed in a Model 430A Mainframe setting on top of a Model 4301A RF Unit Holder.

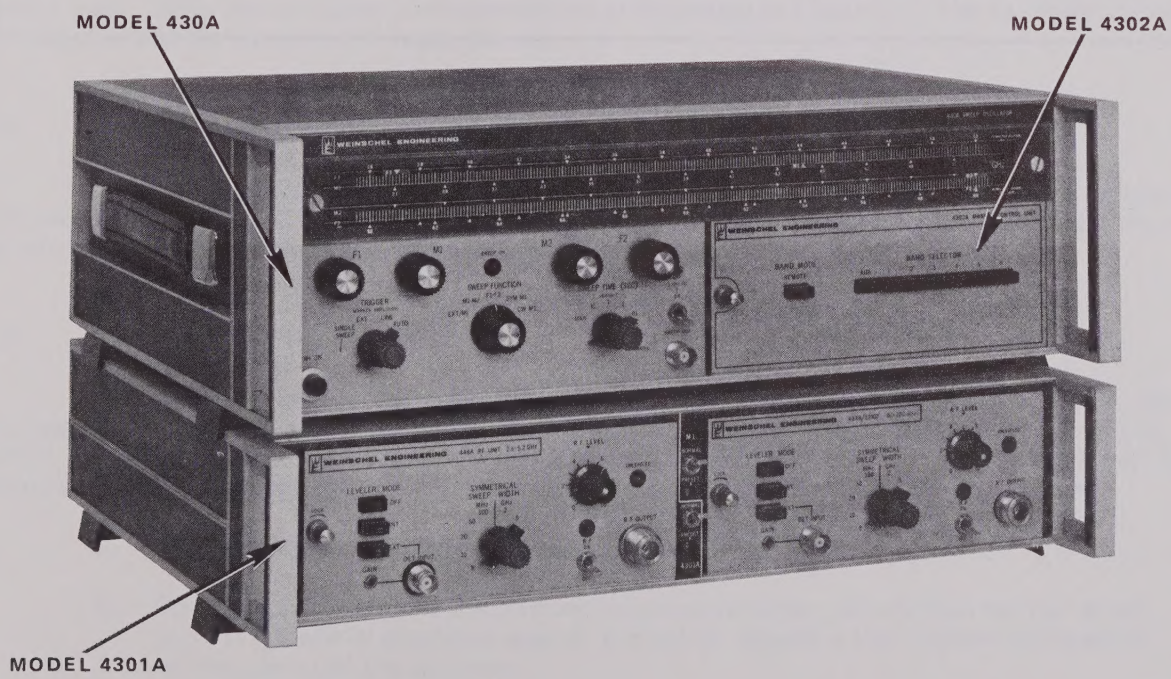


Figure 1-1. A Model 4302A Manual Control Unit installed in a Model 430A Mainframe and associated Model 4301A RF Unit Holder

Table 1-1. Specifications

INTERFACE:	The Model 4302A controls up to 6 RF Units mounted in Model 4301A RF Unit Holders. The 4302A plugs into a Model 430A Mainframe.
SWITCHING TIME BETWEEN RF UNITS:	0.01 sec maximum.
BAND SELECTION-MANUAL:	Front panel pushbutton selects one of 6 RF Units under its control.
BAND SELECTION-REMOTE:	0 volts or ground and +5 volts are applied and are represented as 0 and 1 respectively in the chart below, showing band selection coding, at the pins of REMOTE PROGRAMMING INPUT connector J4.

J4 PINS			SELECTOR
A	B	C	PUSHBUTTON
1	1	1	AUX
1	1	0	1
1	0	1	2
1	0	0	3
0	1	1	4
0	1	0	5
0	0	1	6

SECTION 2

INSTALLATION

2.1 UNPACKING

The Weinschel Engineering Model 4302A Manual Control Unit is shipped in a double carton with two inches of packing material between the inner and outer cartons. Use normal care when unpacking the instrument and removing the packing material. Do not destroy the cartons or packing material until the equipment is thoroughly inspected. If damage is found, notify the carrier immediately and do not destroy any packing material until an agent of the carrier has examined it. Under U. S. shipping regulations, damage claims must be collected by the consignee; do not return the instrument to Weinschel Engineering until a claim for damages has been established.

2.2 INSTALLATION

Two rear panel cable assemblies are supplied for interconnection between the Model 4301A RF Unit Holder and the Model 430A Mainframe. Figure 2-1 illustrates how these cables (IC#2 and IC#3) are connected. IC#1 is supplied with the Model 4301A.

If an RF Unit is plugged into the Model 430A Mainframe it must be removed; but first turn off the AC power. Then install the Model 4302A Manual Control Unit in the Model 430A Mainframe in the same way that an RF Unit would be installed. Replace the frequency scale with the new multiband frequency scale. Make the rear panel cable connections as illustrated in Figure 2-1. The AC power can now be turned on and the equipment is ready for use.

2.3 OPERATING TEMPERATURE RANGE

The Model 4302A is designed to operate within its specifications when the ambient temperature is between 0^{o}C and $+50^{o}$C. Operating in ambient temperatures beyond these limits could affect the accuracy of the instrument and cause damage to its circuits.

2.4 REPACKING FOR SHIPMENT

To protect the unit during reshipment always use the best packaging methods available. When possible, use the original packing containers and cushioning material. Make certain the plug-in Model 4302A is securely locked in position and held there by cushioning material, if installed in the Model 430A during shipment. If the original packing materials are not available use the following procedure:

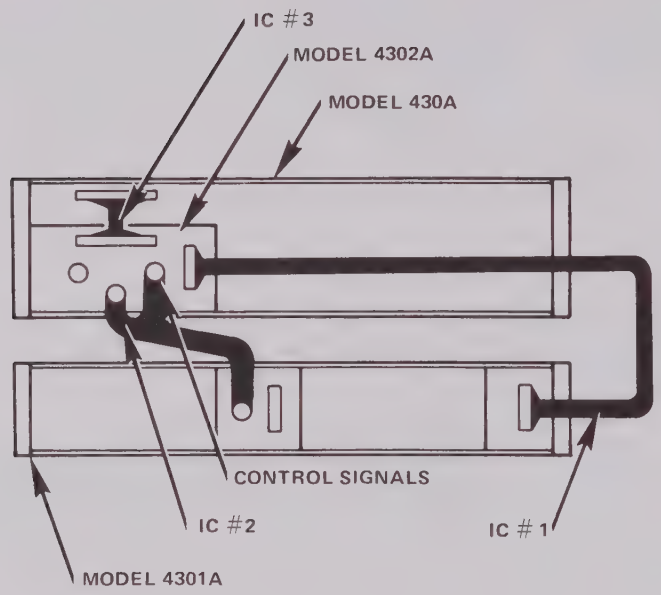
a. Wrap instrument in sturdy paper or plastic.

b. Place wrapped instrument in a strong shipping container; use a ¾-inch layer of shock absorbing material around all sides of the unit to provide a firm cushion and prevent movement inside the container.

c. Thoroughly seal shipping container and mark it as "FRAGILE".

d. If shipping for service attach a tag to indicate:

1. Service required.
2. Description of malfunction.
3. Model and Serial numbers.
4. Return address
5. Authorization to conduct repairs.



IC #3 Wire Color Code	Terminal Numbers	
	Model 430A	Model 4302A
Orange	11	8
Green	10	7
Brown	9	6
Yellow	8	5
Grey	7	4
Shield	6	NC

Figure 2-1. Interconnection cabling diagram for Rear Panels of Model 430A, Model 4301A and Model 4302A

SECTION 3

OPERATING INSTRUCTIONS

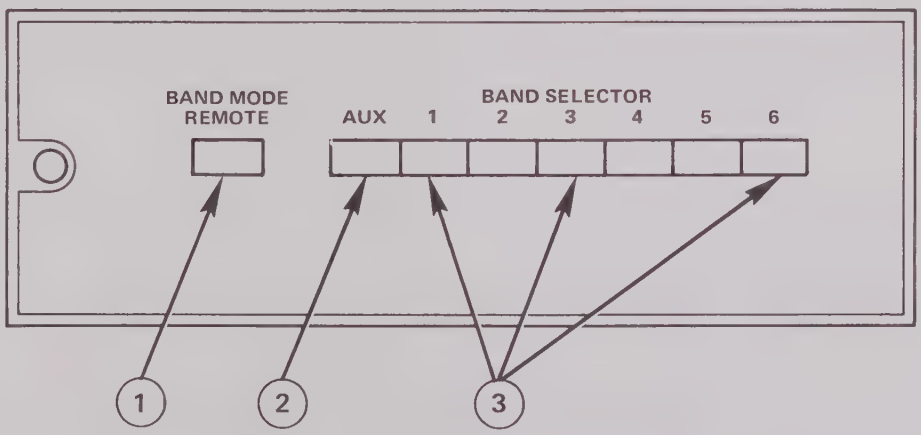
3.1 INTRODUCTION

The Model 4302A Manual Control Unit is a modular building block used for increasing the number of RF Units that can be controlled in a single sweep system. It is designed to permit manual selection of a particular RF Unit by manual front panel pushbuttons or remotely by means of a digital BCD coded wire connection at the rear of the unit. When selected, the RF Unit operates as a single band unit in the same way as if it were plugged into the Model 430A Mainframe directly.

3.2 FRONT AND REAR PANEL FAMILIARIZATION

3.2.1 Front Panel

Figure 3-1 illustrates and explains the function of the front panel controls.



(1) **BAND MODE REMOTE:** When depressed, BCD input at rear panel connector selects RF Band to be operative. BAND SELECTOR pushbuttons are inoperative when BAND MODE REMOTE pushbutton is depressed.

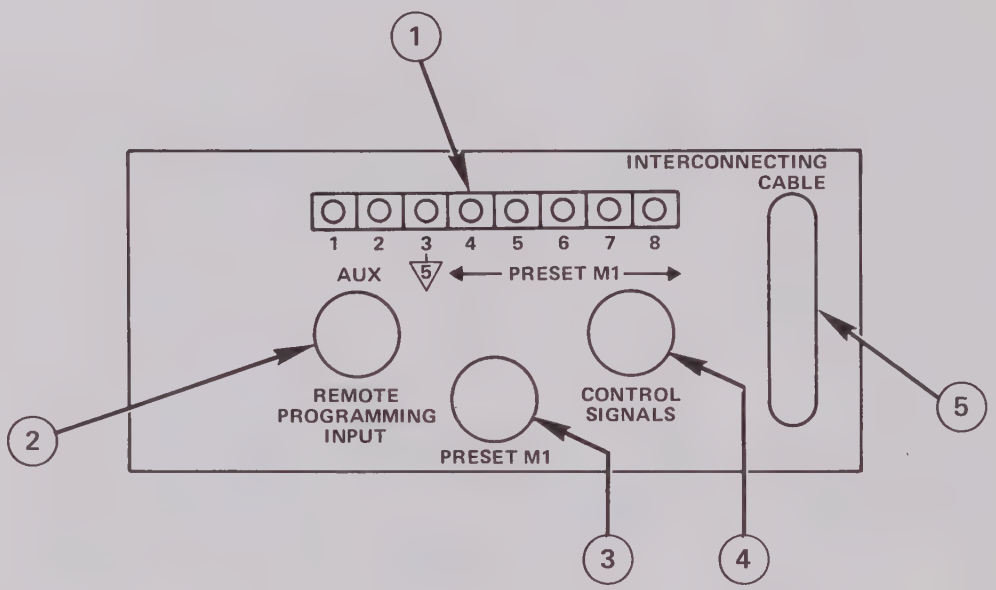
(2) **AUX:** When depressed, control signals available at rear panel are actuated.

(3) **BAND SELECTOR:** Pushbutton 1 through 6 actuate RF Units 1 through 6. Pushbuttons not operative when BAND MODE REMOTE pushbutton is depressed.

Figure 3-1. Front Panel Descriptions

3.2.2 Rear Panel

Figure 3-2 illustrates and identifies connectors located on the rear panel.



1 **TB1:** Terminals 1 and 2 (Auxiliary Control), 4 through 8 connect to Model 430A for Preset M1 operation.

2 **J4-REMOTE PROGRAMMING INPUT:** Accepts BCD input codes for remote selection of RF Units.

3 **J3-PRESET M1:** Provides Preset M1 Operation information for the Model 430A Mainframe input.

4 **J2-CONTROL SIGNALS:** Provides signals for the Model 4301A required to implement selection of RF Units for operation.

5 **J1-INTERCONNECTING CABLE:** Supplies all power and controls signals for the Model 4301A not switched during band selection.

Figure 3-2. Rear Panel Descriptions

SECTION 4

PRINCIPLES OF OPERATION

4.1 INTRODUCTION

The Model 4302A Manual Control Unit serves as an interface between the Model 430A Mainframe and the Model 4301A RF Unit Holders. This section describes the nature of the interconnections and explains the circuit details.

4.2 BLOCK DIAGRAM DESCRIPTION

The power and control signals distributed to the Model 4301A RF Unit Holder are shown in Figure 4-1. The interconnecting cable, IC#3, receives the Preset M1 signals from the Model 430A Mainframe. Interconnecting cables IC#1 and IC#2 transmit the power and control signals, respectively, to the Model 4301RF Unit Holder.

The 36-conductor cable is essentially routed through and out of the Model 4302A except for lead #8, which constitutes a control signal for the Preset M1 circuitry.

A group of circuits labeled REMOTE-LOCAL Band Selection receives inputs from the front panel pushbuttons and the remote programming input, decodes them and transmits them (the band selection information) to the Model 4301A RF Unit Holder.

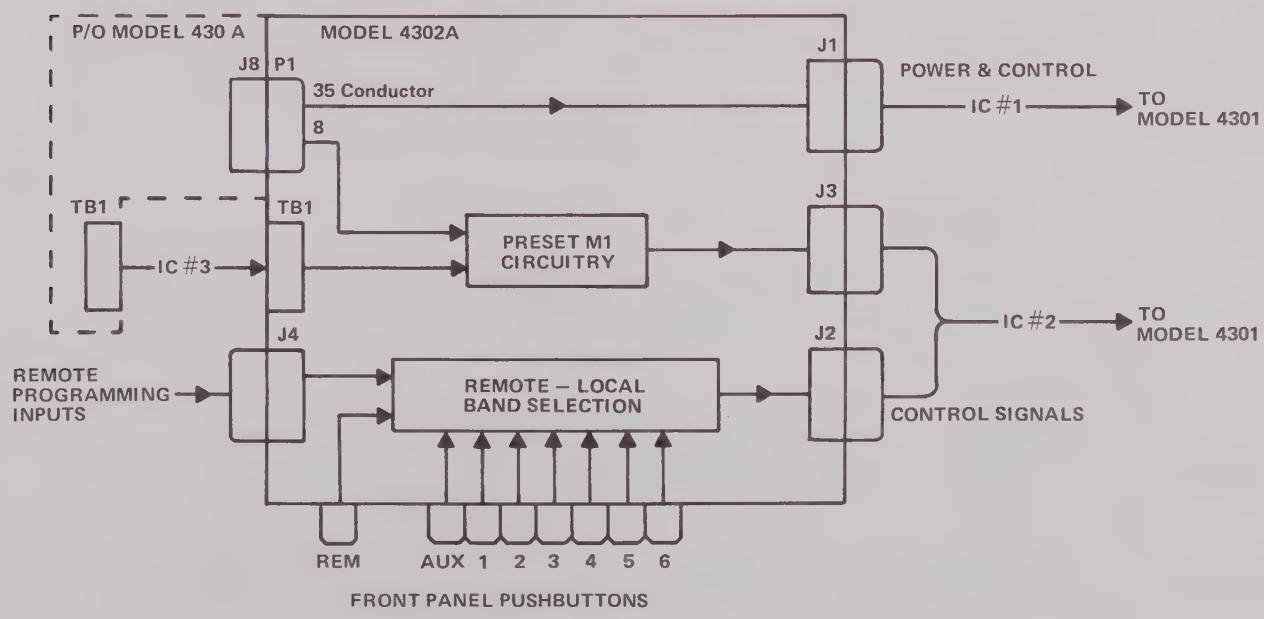


Figure 4-1. Block Diagram, Model 4302A Manual Control Unit

4.3 REMOTE-LOCAL BAND SELECTION

The local mode is selected when the front panel BAND-MODE-REMOTE button on the Model 4302A is not depressed. Referring to Figure 4-2, it can be seen that this position of the REMOTE pushbutton connects IC1-12, 13 to ground, causing IC1-11 to go "high" and thereby enabling the three gates of IC3. However, when BAND SELECTOR pushbutton 1 is depressed, IC3-2 is grounded causing IC3-3 to go "high". Since IC-5 and IC3-10 remain "high", IC3-6 and IC3-8 are "low". This combination appears at IC2 when A is "high", B is "low", C is "low" which is decoded as 1 and IC2-1 goes "low". It should be noted that the remote programming input has been isolated because the grounding of Input 2, 5, 10 of IC-1 causes the output of IC1-3, 6, 8 to remain "high".

In a similar fashion, other band selector pushbuttons will actuate IC3 to cause the appropriate output of IC2 to go "low".

When the remote pushbutton is depressed, the ground connection to IC1-12, 13 is removed causing IC1-11 to go "low", thereby disabling the three gates of IC3. The three remote gates are now enabled because IC1-2, 5, 10 are high. If input A (IC1-1) is made "low" and inputs B and C "high", the three remote gates of IC1 invert these signals, thereby making A "high", B "low", C "low". This combination is decoded as 1 and IC2-1 goes "low".

In the remote position, provision is made to remotely turn the RF power on or off via lead E on the remote programming input connector. If E is made "low" then inputs IC2-A, B, C go "high" and decode a band number higher than 6. This, in effect, turns off all bands 1 through 6.

When a particular band is selected, as shown above, the output lead from IC2 corresponding to that band is made "low". For example, when IC2-6 goes "low", Q8 is turned on and +5V is applied to the control signal output connector to signal the turn-on of band 6.

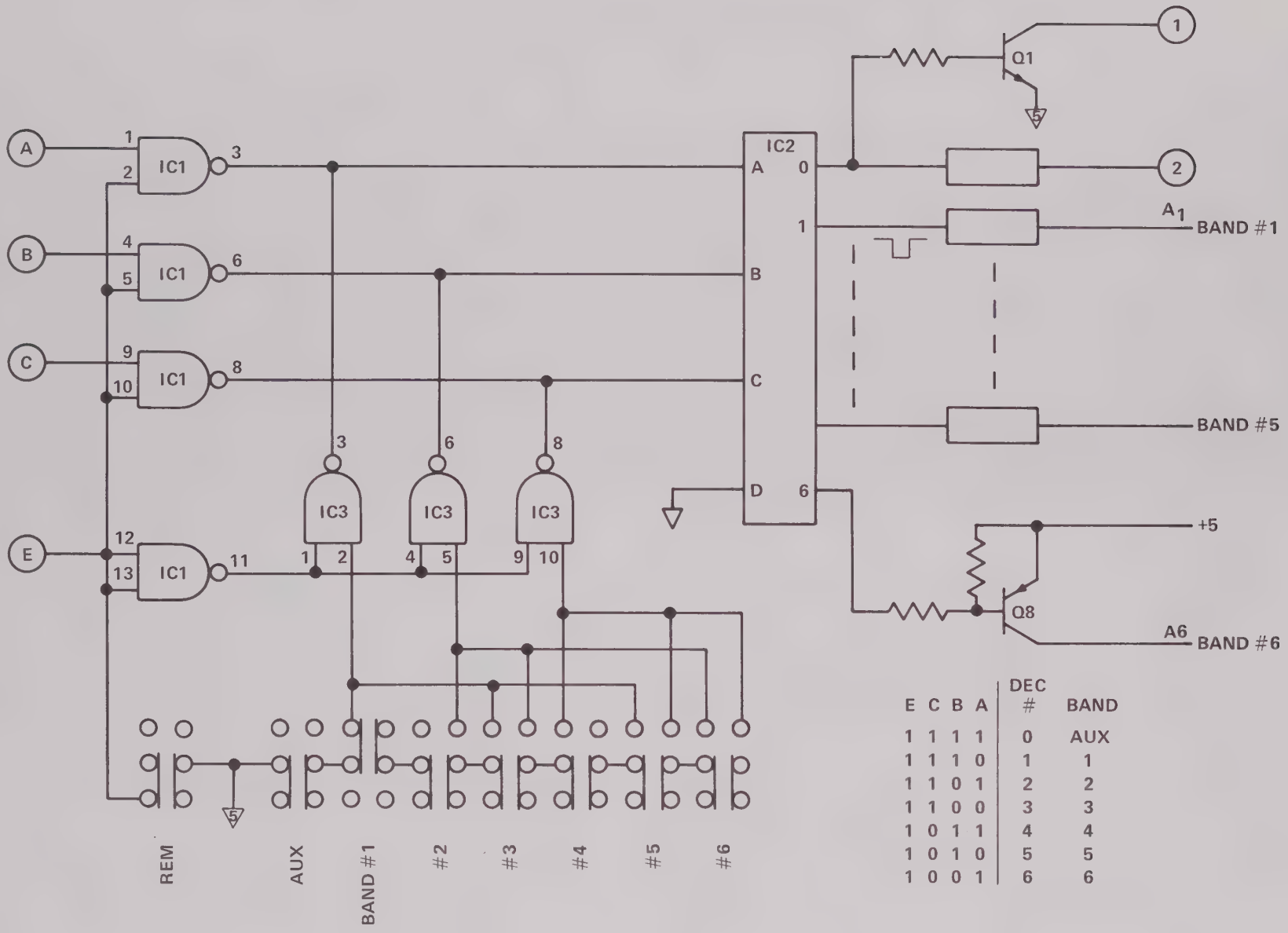
When a band position pushbutton is depressed in the local mode, all other band selector pushbuttons are released by a mechanical linkage. This mechanism operates to release all other pushbuttons except the one being depressed. Therefore, when the AUX pushbutton is depressed all inputs to the IC3 gates are "high", causing IC2-A, B, C to go "low" and it decodes the output as "0". The IC2-0 output goes "low" and applies +5 volts to TB1-2 and also turns on Q1, providing TB1-1 with a collector-to-emitter short to ground.

4.4 PRESET M1 FUNCTION

With the Sweep Function selector of the Model 430A Mainframe in either the SYM M1 or CW M1 position, either the M1 control on the Model 430A or the Preset M1 control on the 4301A RF Unit Holder is actuated. Figure 4-3 is a simplified schematic showing how this Preset M1 function operates.

When SYM M1 or CW M1 is selected, +5V is applied to one side of the relay coil in the Model 4302A via pin Number 8 of the 36-pin interface connector. The other side of the relay coil is grounded via Q6 in one of the solid state switches in the Model 4301A if the Preset/Normal Switch is in the preset poisition and if an A_X signal (band select control signal) is applied to that particular solid state switch.

With the relay coil circuit being complete, the relay in the Model 4302A is thrown into the preset position connecting the preset M1 potentiometer into the M1 position in the tuning voltage circuits of the Model 430A.



E	C	B	A	DEC #	BAND
1	1	1	1	0	AUX
1	1	1	0	1	1
1	1	0	1	2	2
1	1	0	0	3	3
1	0	1	1	4	4
1	0	1	0	5	5
1	0	0	1	6	6

Figure 4-2. Remote-Local Band Selection

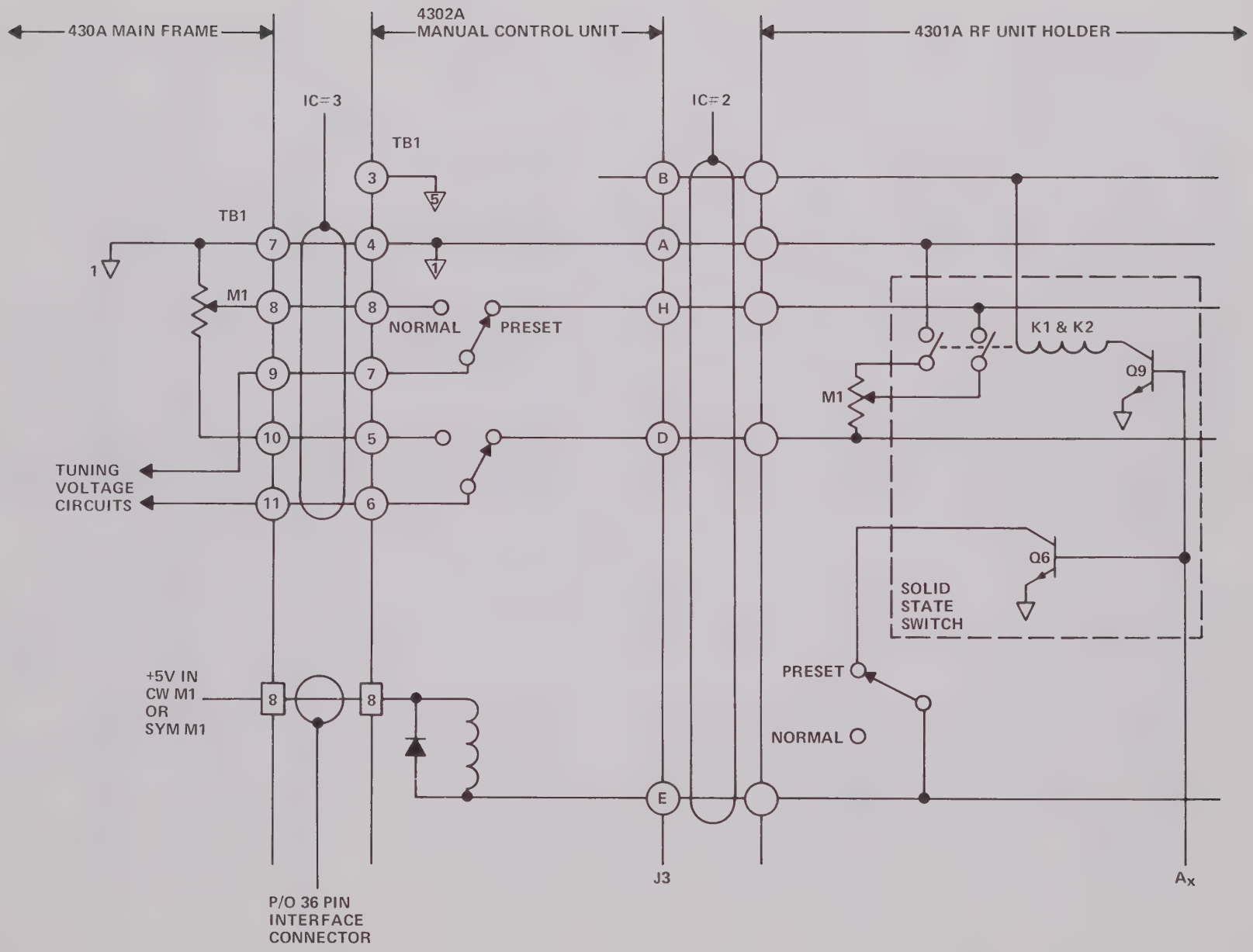


Figure 4-3. Preset M1

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

This section provides the information required to maintain and service the Model 4302A Manual Control Unit including performance tests. No calibration or alignment is required for the Model 4302A.

5.2 REQUIRED TEST EQUIPMENT

A general purpose volt/ohm meter is the only piece of test equipment needed to completely check the Model 4302A.

5.3 PERFORMANCE TESTS

The following performance tests provide a method to verify whether the Model 4302A is operating within the specifications given in Table 1-1. The tests may be used as part of the incoming quality control inspection, as a periodic operational check or after maintenance and service has been performed.

5.3.1 Local Switching Mode

Insert the Model 4302A into the Model 430A Mainframe but do not connect any cables to the rear of the Model 4302A.

a. Solder a six-inch piece of hook-up wire to one side of a 4.7K, ±10%, ¼ watt carbon composition resistor and connect the other end of the wire to pin 3 of TB1.

b. Apply main power to the Model 430A Mainframe and depress BAND SELECTOR 1 pushbutton on the Model 4302A.

c. Insert the free end of the 4.7K resistor into PIN A of the rear panel J2 connector on the Model 4302A.

d. Set the voltmeter for a reading of approximately +5 volts and connect it across the 4.7K resistor (+ to J2 connector side of resistor). The meter should indicate 5 (±1) volts.

e. Sequentially depress the remaining pushbuttons, except the BAND MODE REMOTE. The meter should indicate 5 (±1) volts only when the pushbutton corresponding to the appropriate J2 pin number being monitored is depressed (See Table 5-1). The meter should read zero at all other times.

f. Remove the 4.7K resistor from J2 pin A and insert it into pin B of J2. The voltmeter should indicate +5 volts only when BAND 2 pushbutton is depressed.

Table 5-1. Local Mode Switching Voltages

BAND SELECTOR	J2 CONNECTOR						TB1	
	A	B	C	D	E	F	PIN 1	PIN 2
AUX	0V	0V	0V	0V	0V	0V	OPEN COLLECTOR	+5
BAND 1	+5V	0	0	0	0	0	GND	0V
BAND 2	0	+5V	0	0	0	0	GND	0V
BAND 3	0	0	+5V	0	0	0	GND	0V
BAND 4	0	0	0	+5V	0	0	GND	0V
BAND 5	0	0	0	0	+5V	0	GND	0V
BAND 6	0	0	0	0	0	+5V		

g. Repeat this procedure for bands 3 through 6 inserting the test resistor into pins C, D, E and F, respectively.

h. Connect the voltmeter between TB1 pin 3 (GND) and TB1 pin 1 (+).

i. Connect the 4.7K, ±10%, ¼ watt resistor between TB1 pin 1 and pin B on J3. Meter should indicate +5 (±1) volts. When any of the other BAND SELECTOR pushbuttons are depressed the meter should indicate 0.4 (±0.4) volts.

j. Connect the 4.7K, resistor between TB1 pin 3 and TB1 pin 2. Connect the meter across the 4.7K resistor with the (+) lead to TB1 pin 2.

k. The meter should indicate +5 (±1) volts when the AUX button is depressed and 0 volts when any BAND SELECTOR pushbuttons are depressed.

5.3.2 Remote Switching Mode

a. Using the test resistor and piece of wire assembled in Paragraph 5.3.1, connect one end of the wire to pin 3 of TB1.

b. Apply main power to the Model 430A.

c. On the Model 4302A, depress the BAND MODE REMOTE pushbutton.

d. Insert the free end of the resistor (4.7K) into pin A of the rear panel connector J2 on the Model 4302A.

e. On connector J4 of the Model 4302A, connect pin E to ground and apply input logic levels to pins A, B, and C as indicated in Table 5-2 for BAND 1.

f. Connect voltmeter leads across the 4.7K resistor (+ lead to J2 side of resistor). The meter should indicate 5 (±1) volts.

g. With the voltmeter still connected across the resistor, apply logic levels in sequence to J4 pins as indicated by Table 5-2 and observe that the meter indication remains at zero volts.

h. Remove the test resistor from J2, pin A and insert it into J2, pin B and apply the proper logic levels. The voltmeter reading across the resistor should indicate 5 (±1) volts.

Table 5-2. Remote Mode Switching Voltages

REMOTE BAND SELECTED	REQUIRED INPUT LOGIC* LEVELS AT J4			OUTPUT VOLTAGES J2						OUTPUT VOLTAGES TB1	
	C	B	A	A	B	C	D	E	F	1	2
AUX	1	1	1	0V	0V	0V	0V	0V	0V	OPEN CKT	+5V
BAND 1	1	1	0	+5V	0	0	0	0	0	GND	0V
BAND 2	1	0	1	0	+5V	0	0	0	0	GND	0V
BAND 3	1	0	0	0	0	+5V	0	0	0	GND	0V
BAND 4	0	1	1	0	0	0	+5V	0	0	GND	0V
BAND 5	0	1	0	0	0	0	0	+5V	0	GND	0V
BAND 6	0	0	1	0	0	0	0	0	+5V	GND	0V

*Logic "0" = ground or zero volts; Logic "1" = +5V or open circuit (Standard DTL or TTL levels)

i. Apply logic levels in sequence to J4 pins as indicated by Table 5-2 and observe that the meter indication remains at zero.

j. Repeat this procedure for bands 3 through 6 inserting the test resistor into J4, pins C, D, E and F, respectively. The voltmeter should only measure +5 (±1) volts, as indicated by Table 5-2, when the proper logic levels are applied.

k. Connect the test resistor between pins 3 and 2 of TB1 and measure the voltage across the resistor (+ lead to TB1-2). The meter should indicate +5 (±1) volts only when logic 1's are applied to J4, pins A, B and C. All other logic inputs should result in a zero volt reading.

l. Remove the ground connection from J4, pin E.

5.3.3 Preset M1 Control

a. Set the multimeter to measure continuity and connect the leads between TB1 pin 5 and TB1 pin 6. The meter should read zero ohms.

b. Connect the meter between TB1 pin 7 and TB1 pin 8. The meter should read zero ohms.

c. Connect a piece of hook-up wire between TB1 pin 3 and J3 pin E. The meter connected between pins 7 and 8 of TB1 should read ∞ when the Model 430A SWEEP FUNCTION switch is in either the CW M1 or SYM M1 positions. The meter should read zero ohms for any other position of the SWEEP FUNCTION switch.

d. Connect the meter between TB1 pin 5 and TB1 pin 6. The meter should read ∞ when the SWEEP FUNCTION switch is in CW M1 or SYM M1 position. For any other position of the SWEEP FUNCTION switch the meter should read zero ohms.

e. Set the SWEEP FUNCTION switch to the CW M1 position. Connect the ohm meter between TB1 pin 6 and J3 pin A. The meter should read zero ohms in the CW M1 and SYM M1 positions of the SWEEP FUNCTION switch only.

f. Connect the ohm meter between TB1 pin 8 and pin D of J3. The meter should read zero ohms only when the SWEEP FUNCTION switch is set to either CW M1 or SYM M1.

This completes the performance checks for the Model 4302A. No calibration or alignment steps are required.

SECTION 6

REPLACEABLE PARTS

6.1 INTRODUCTION

This section provides information for procuring replaceable parts for the Model 4302A Manual Control Unit. The parts listed include all parts subject to burnout, breakage or deterioration during normal operation of the equipment.

6.2 REFERENCE DESIGNATIONS & ABBREVIATIONS

See Table 6-1 for a complete explanation of reference designations and abbreviations.

6.3 ORDERING INFORMATION

The following information should be included when ordering replacement parts for the Model 4302A Manual Control Unit.

a. Weinschel Engineering part number and description.

b. The instrument model number and serial number.

c. If ordering a part not included in the replaceable parts list, include a complete description of the part, its function and its location within the equipment.

Table 6-1. Abbreviations and Reference Designations

All reference designations for electrical parts will be preceded by a prefix which will indicate the assembly in which it is contained. These prefixed will be identified as follows:

A1 – CONTROL LOGIC BOARD
* – BASIC CHASSIS ASSEMBLY
** – Includes all parts within Basic Chassis Assembly not included in Assembly A1

ABBREVIATIONS

A	–	Amperes	FWD	–	Forward	PC	–	Printed Circuit
AMPL	–	Amplifier	G	–	Giga = 10^9	PF	–	Pico farads = 10^{-12} farads
AM	–	Amplitude modulation	GRD	–	Ground			
APPROX	–	Approximate	H	–	Henry	P/O	–	Part of
ASS'Y	–	Assembly	Hz	–	Cycle per second	P-P	–	Peak to Peak
AUX	–	Auliliary	IDENT	–	Identification	RECT	–	Rectifier
AVG	–	Average	IMP	–	Impulse	RES	–	Resistance or Resistor
BAL	–	Balance	INT	–	Internal	RET	–	Return
BWO	–	Backward wave oscillator	K	–	Kilo = 10^3	REV	–	Reverse
			LIN	–	Linear	RF	–	Radio Frequency
C	–	Cathode	M	–	Milli = 10^{-3}	RMS	–	Square root of mean square
CAL	–	Calibrator	MAX	–	Maximum			
CCW	–	Counterclockwise	MEG	–	Meg = 10^6	SEC	–	Second
CW	–	Clockwise	MFG	–	Manufacturer	SW	–	Switch
dB	–	Decibel	MIN	–	Minimum	SYM	–	Symmetrical
dBm	–	Decibel (referred to 1 milliwatt in 600 ohms)	N	–	Nano = 10^{-9}	TRIG	–	Trigger
			NC	–	Normally closed	TYP	–	Typical
EXT	–	External	NEG	–	Negative	U	–	Micro = 10^{-6}
F	–	Farad	NO	–	Normally open	V	–	Volt
FIG	–	Figure	Ω	–	Ohm	VAR	–	Variable
FIX	–	Fixed	O	–	Peak	W	–	Watts
FM	–	Frequency Modulate	J	–	Jack	R	–	Resistor
A	–	Assembly	K	–	Relay	S	–	Switch
B	–	Motor	L	–	Inductor	T	–	Transformer
C	–	Capacitor	M	–	Meter	TB	–	Terminal Board
CR	–	Diode	P	–	Plug	V	–	Vacuum
DS	–	Lamp	Q	–	Transistor	X	–	Socket
F	–	Fuse						

Table 6-2. Basic Chassis Assembly, Model 4302A Parts List (D139-187)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1	C139-171	Control Logic Assembly	93459	
J1	62-150	Connector, Receptacle	13511	57-40360
J2	62-76	Connector, Receptacle	13511	126-221
J3	62-74	Connector, Receptacle	13511	126-218
J4	62-76	Connector, Receptacle	13511	126-221
P1	62-161	Connector Plug	13511	57-10360
TB1	65-6-10	Terminal Block 8 Contacts	75382	410-Y-8
IC-1	B139-504	Cable Assy. No. 1 Interconnections	93458	
IC-2	B139-546-1	Cable Assy. No. 2 Cont. Signal	93459	
IC-3	B139-507-2	Cable Assy. No. 3 Preset M1	93459	

Table 6-3. Assembly A1, Control Logic Parts List

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1	C139-171	Control Logic Assembly	93459	
A1CR1	12-99	Diode		1N483B
A1IC1	12-163	Interg. Circuit	04713	MC846P
A1IC2	12-207	Interg. Circuit	01295	SN7442N
A1IC3	12-163	Interg. Circuit	04713	MC846P
A1K1	47-29	Relay	12300	JRM1049
A1Q1	12-139	Transistor		2N4401
A1Q2	12-140	Transistor		2N4403
A1Q3	12-140	Transistor		2N4403
A1Q4	12-140	Transistor		2N4403
A1Q5	12-140	Transistor		2N4403
A1Q6	12-140	Transistor		2N4403
A1Q7	12-140	Transistor		2N4403
A1Q8	12-140	Transistor		2N4403
A1R1	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A1R2	25-25-2200	Res., 2.2K, 5%, ¼W		RC07GF222J
A1R3	25-25-1000	Res., 1K, 5%, ¼W		RC07GF102J
A1R4	25-25-2200	Res., 2.2K, 5%, ¼W		RC07GF222J
A1R5	25-25-1000	Res., 1K, 5%, ¼W		RC07GF102J
A1R6	25-25-2200	Res., 2.2K, 5%, ¼W		RC07GF222J
A1R7	25-25-1000	Res., 1K, 5%, ¼W		RC07GF102J
A1R8	25-25-2200	Res., 2.2K, 5%, ¼W		RC07GF222J
A1R9	25-25-1000	Res., 1K, 5%, ¼W		RC07GF102J
A1R10	25-25-2200	Res., 2.2K, 5%, ¼W		RC07GF222J
A1R11	25-25-1000	Res., 1K, 5%, ¼W		RC07GF102J
A1R12	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A1R13	25-25-1000	Res., 1K, 5%, ¼W		RC07GF102J
A1R14	25-25-2200	Res., 2.2K, 5%, ¼W		RC07GF222J
A1R15	25-25-1000	Res., 1K, 5%, ¼W		RC07GF102J
A1R16	25-27-22	Res., 22 ohm, 5%, ½W		RC07GF220J
A1S1	B55-53	Switch, Push Button, P.C.	93459	

SECTION 7

DRAWINGS AND SCHEMATICS

7.1 INTRODUCTION

This section contains assembly drawings, schematic diagrams and component location drawings for the Model 4302A Manual Control Unit assembly and sub-assemblies.

7.2 LIST OF FIGURES

Figure	Description	Page
7-1	Chassis Component Assembly	7-3/7-4
7-2	4302A Overall Schematic	7-5/7-6

Table 7-1. Schematic Notes

1. Resistance in ohms, capacitance in microfarads unless otherwise indicated.

2. Screwdriver adjustment

Front panel control

3. Front panel designation

Rear panel designation

4. Printed circuit card border

 Main signal path

Semi-Rigid Coaxial

5. P/O = part of

6.

Wiper moves toward CW when control rotated clockwise

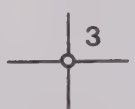
7. Test point.

8. Zener diode; SCR

9. Cons. Current Diode

10.

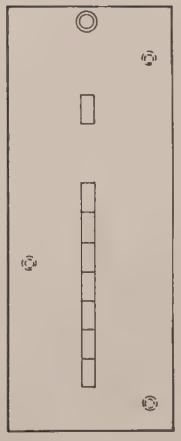
Indicates Socket connections and pin numbers.

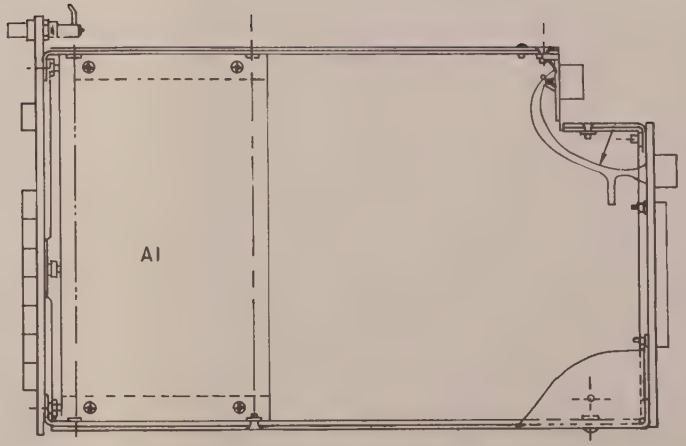
11. 

Indicates solder connection and pin numbers.

12. Denotes chassis ground

13. Denotes signal ground





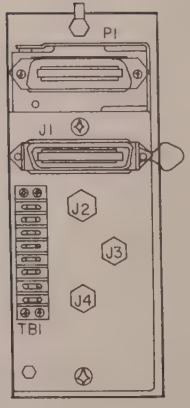
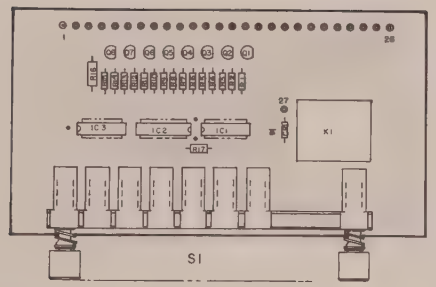


Figure 7-1. Model 4302A, Assembly and Component Identification



NOTES

1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS 5% 1/4W TRANSISTORS ARE NPN 2N4401, PNP 2N4403

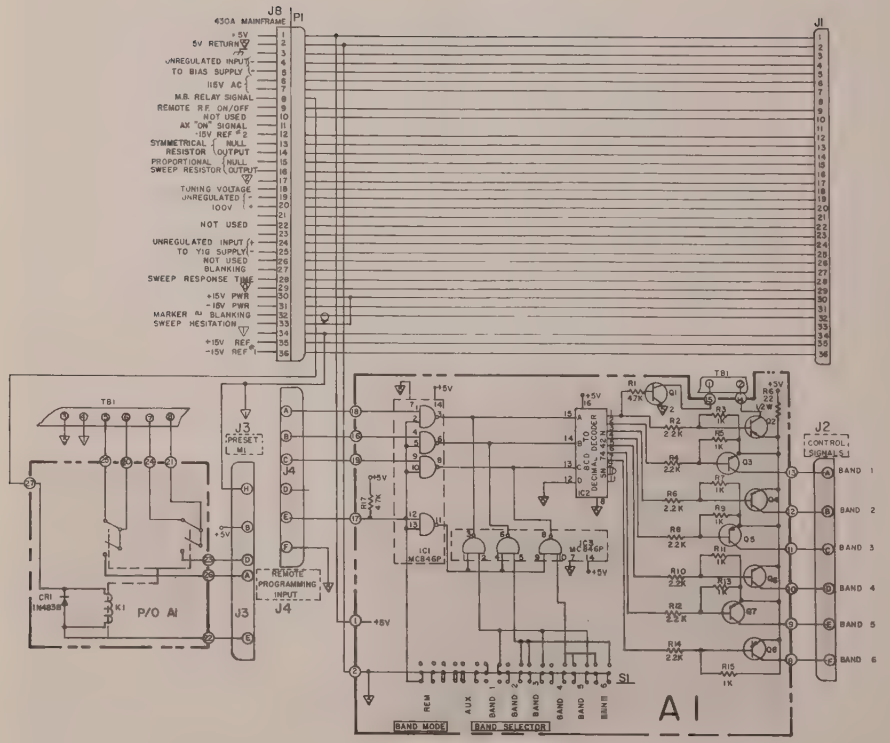


Figure 7-2. Model 4302A, Overall Schematic Diagram

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer/Address
00000	U.S.A. Common: Any supplier of U.S.
00136	McCoy Electronics: Mount Holly Springs, Pa.
00213	Sage Electronics Corp.: Rochester, N.Y.
00287	Cemco Inc.: Danielson, Conn.
00334	Humidial: Colton, Calif.
00348	Microtron Co., Inc.: Valley Stream, N.Y.
00373	Garlock Inc.: Cherry Hill, N.J.
00656	Aerovox Corp.: New Bedford, Mass.
00779	Amp. Inc.: Harrisburg, Pa.
00781	Aircraft Radio Corp.: Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.: Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.: Pickens, S.C.
00866	Goe Engineering Co.: City of Industry, Calif.
00891	Carl F. Holmes Corp.: Los Angeles, Calif.
00929	Microlab Inc.: Livingston, N.J.
01002	General Electric Co., Capacitor Dept.: Hudson Falls, N.Y.
01009	Alden Products Co.: Brockton, Mass.
01121	Allen Bradley Co.: Milwaukee, Wis.
01255	Litton Industries, Inc.: Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.: Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.: Dallas, Texas
01349	The Alliance Mfg. Co.: Alliance, Ohio
01589	Pacific Relays, Inc.: Van Nuys, Calif.
01670	Gudebrod Bros, Silk Co.: New York, N.Y.
01884	Sprague: Longwood, Fla.
01930	Amerock Corp.: Rockford, Ill.
01961	Pulse Engineering Co. : Santa Clara, Calif.
02114	Ferroxcube Corp. of America: Saugerties, N.Y.
02116	Wheelock Signals, Inc.: Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.: Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.: Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.: Somerville, N.J.
02771	Vocaline Co. of America, Inc.: Old Saybrook, Conn.
02777	Hopkins Engineering Co.: San Fernando, Calif.
02875	Hudson Tool & Die Co.: Newark, N.J.
03508	G. E. Semiconductor Prod. Dept.: Syracuse, N.Y.
03705	Apex Machine & Tool Co.: Dayton, Ohio
03797	Eldema Corp.: Compton, Calif.
03818	Parker Seal Co.: Los Angeles, Calif.
03877	Transitron Electric Corp.: Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.: Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant: Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.: Hartford, Conn.
04013	Taurus Corp.: Lambertville, N.J.
04062	Arco Electronic Inc.: Great Neck, N.Y.
04222	Hi-Q Division of Aerovox: Myrtle Beach, S.C.
04354	Precision Paper Tube Co.: Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.: Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.: Mountain View, Calif.
04673	Dakota Engr. Inc.: Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.: Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.: Culver City, Calif.
04773	Automatic Electric Co.: Northlake, Ill.
04796	Sequoia Wire Co.: Redwood City, Calif.
04811	Precision Coil Spring Co. : El Monte, Calif.
04870	P. M. Motor Company: Westchester, Ill.
04919	Component Mfg. Service Co.: W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.: Los Angeles, Calif.
05245	Components Corp.: Chicago, Ill.
05277	Westinghouse Electric Corp., Semi-Conductor Dept. Youngwood, Pa.
05347	Ultronix, Inc.: San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.: New York, N.Y.
05574	Viking Ind. Inc.: Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.: Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.): Cleveland, Ohio
05624	Barber Colman Co.: Rockford, Ill.
05728	Tiffen Optical Co.,: Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.: Westbury, N.Y.
05783	Stewart Engineering Co.: Santa Cruz, Calif.
05820	Wakefield Engineering Inc.: Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.: Bridgeport, Conn.
06090	Raychem Corp.: Redwood City, Calif.
06175	Bausch and Lomb Optical.: Rochester, N.Y.
06402	E.T.A. Products Co. of America: Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.: New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.: Penacook, N.H.
06666	General Devices Co., Inc.: Indianapolis, Ind.
06751	Components Inc., Ariz. Div.: Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.: Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.: San Carlos, Calif.
07088	Kelvin Electric Co.: Van Nuys, Calif.
07126	Digitran Co.: Pasadena, Calif.
07137	Transistor Electronics Corp.: Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.: Elmira, N.Y.
07149	Filmohm Corp.: New York, N.Y.
07233	Cinch-Graphik Co.: City of Industry, Calif.
07256	Silicon Transistor Corp.: Carle Place, N.Y.
07261	Avnet Corp.: Culver City, Calif.
07263	Fairchild Camera & Inst. Corp, Semiconductor Div.: Mountain View, Calif.
07322	Minnesota Rubber Co.: Minneapolis, Minn.
07387	Birtcher Corp., The: Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc.,: Mt. View Operations: Mountain View, Calif.
07700	Technical Wire Products Inc.: Cranford, N. J.
07829	Bodine Elect. Co.: Chicago, Ill.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
07910	Continental Device Corp.: Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.: Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.: Rockaway, N.J.
08145	U.S. Engineering Co.: Los Angeles, California
08289	Blinn, Delbert Co.: Pomona, Calif.
08358	Burgess Battery Co.: Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.: Los Angeles, Calif.
08664	Bristol., The: Waterbury, Conn.
08717	Sloan Company: Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.: Phoenix, Arizona
08727	National Radio Lab. Inc.: Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of C. B. S. Inc.: Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.: Cleveland, Ohio
08984	Mel-Rain: Indianapolis, Ind.
09021	Airco Speer: Bedford, Pa.
09026	Babcock Relays Div.: Costa Mesa, Calif.
09134	Texas Capacitor Co.: Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.: Burbank, Calif.
09250	Electro Assemblies, Inc.: Chicago, Ill.
09353	C & K Components Inc.: Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.: Toronto, Ontario, Canada
09922	Burndy Corp.: Norwalk, Conn.
09969	Dale: Yankgon, S.D.
10214	General Transistor Western Corp.: Los Angeles, Calif.
10411	Ti-Tal, Inc.: Berkeley, Calif.
10646	Carborundum Co.: Niagara Falls, N.Y.
11236	CTS of Berne, Inc.: Berne, Ind.
11237	Chicago Telephone of California, Inc.: So. Pasadena, Calif.
11242	Bay State Electronics Corp.: Waltham, Mass.
11312	Teledyne Inc., Microwave Div.: Palo Alto, Calif.
11314	National Seal: Downey, Calif.
11453	Precision Connector Corp.: Jamaica, N.Y.
11534	Duncan Electronics Inc.: Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group: Newark, N.J.
11717	Imperial Electronic, Inc.: Buena Park, Calif.
11870	Melabs, Inc.: Palo Alto, Calif.
12040	National Semiconductor: Danbury, Conn.
12136	Philadelphia Handle Co.: Camden, N.J.
12300	Potter and Brumfield: Ontario, Canada
12361	Grove Mfg. Co., Inc.: Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.: Albuquerque, N.M
12697	Clarostat Mfg. Co.: Dover, N.H.
12728	Elmar Filter Corp.: W. Haven, Conn.
12859	Nippon Electric Co., Ltd.: Tokyo, Japan
12881	Metex Electronics Corp.: Clark, N.J.
12930	Delta Semiconductor Inc.: Newport Beach, Calif.
12954	Dickson Electronics Corp.: Scottsdale, Arizona
13103	Thermolloy: Dallas, Texas
13396	Telefunken (GmbH): Hanover, Germany
13511	Amphenol: Gatos, Calif.
13835	Midland-Wright Div. of Pacific Industries, Inc.: Kansas City, Kansas
14099	Sem-Tech: Newbury Park, Calif.
14193	Calif. Resistor Corp.: Santa Monica, Calif.
14298	American Components, Inc.: Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.: West Palm Beach, Fla.
14493	Hewlett-Packard Company: Loveland, Colo.
14655	Cornell Dublier Electric Corp.: Newark, N.J.
14674	Corning Glass Works: Corning, N.Y.
14752	Electro Cube Inc.: San Gabriel, Calif.
14960	Williams Mfg. Co: San Jose, Calif.
15203	Webster Electronics Co.: New York, N.Y.
15287	Scionics Corp.: Northridge, Calif.
15291	Adjustable Bushing Co.: N. Hollywood, Calif.
15556	Micron Electronics: Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.: Lynbrook, N.Y.
15631	Cabletronics: Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.,: Santa Clara, Calif
15801	Fenwal Elect. Inc.: Framingham, Mass
15818	Amelco Inc.: Mt. View, Calif.
16037	Spruce Pine Mica Co.: Spruce Pine, N.C.
16179	Omni-Spectra Inc.: Farmington, Mich.
16352	Computer Diode Corp.: Lodi, N.J.
16585	Boots Aircraft Nut Corp.: Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.: Brooklyn, N.Y.
16758	Delco Radio Div. of G. M. Corp.: Kokoma, Ind
17109	Thermonetics Inc.: Canoga Park, Calif.
17474	Tranex Company: Mountain View, Calif.
17554	Components Inc.: Biddeford, Ma.
17675	Hamlin Metal Products Corp.: Akron, Ohio
17745	Angstrohm Prec. Inc.: No Hollywood, Calif.
17870	McGraw-Edison Co.: Manchester, N.H.
18042	Power Design Pacific Inc.: Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.: Palo Alto Calif.
18324	Signetics Corp.: Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.: Holliston, Mass.
18486	TRW Elect. Comp. Div.: Des Plaines, Ill.
18583	Curtis Instrument, Inc.: Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.: Malvern, Pa.
18873	E. I. DuPont and Co., Inc.: Wilmington, Del.
18911	Durant Mfg. Co.: Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.: Teterboro N. J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.: West Orange, N.J.
19589	Concoa: Baldwin Park, Calif.
19644	LRC Electronics: Horseheads, N.Y.
19701	Electra Mfg. Co.: Independence, Kansas
20183	General Atronics Corp.: Philadelphia, Pa.
21226	Executone, Inc.: Long Island City, N.Y.
21335	Fafnir Bearing Co., The: New Britain, Conn.
21520	Fansteel Metallurgical Corp.: N. Chicago, Ill.
23042	Texscan Corp.: Indianapolis, Ind.
23783	British Radio Electronics Ltd.: Washington, D.C
24455	G. E. Lamp Division: Nela Park, Cleveland, Ohio
24655	General Radio Co.: West Concord, Mass.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
24681	Memcor Inc., Comp. Div.: Huntington, Ind.
24796	Parelco Inc.: San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.: New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.: Carlstadt, N J
26851	Compac/Hollister Co.: Hollister, Calif.
26992	Hamilton Watch Co.: Lancaster, Pa.
27014	National Semi-Conductor: Santa Clara, Calif.
27251	Specialities Mfg. Co., Inc.: Stratford, Conn.
28480	Hewlett-Packard Co.: Palo Alto, Calif.
28520	Heyman Mfg. Co.: Kenilworth, N. J.
30817	Instrument Sepcialities Co., Inc.: Little Falls, N.J.
31433	Union Carbide: Greenville, S.C.
33173	G. E. Receiving Tube Dept.: Ownesboro, Ky.
35434	Lectrohm Inc.: Chicago, Ill
36196	Stanwyck Coil Products Ltd.: Hawkesbury, Ontario, Canada
36287	Cunningham, W. H. & Hill, Ltd.: Toronto Ontario, Canada
37942	P. R. Mallory & Co. Inc.: Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.: Akron, Ohio
40920	Miniature Precision Bearings, Inc.: Keene, N. H.
42190	Muter Co.: Chicago, Ill.
43990	C. A. Norgren Co.: Englewood, Colo.
44655	Ohmite Mfg. Co.: Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.: Doylestown, Pa.
47904	Polaroid Corp.: Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.: Southampton, Pa.
49956	Microwave & Power Tube Div.: Waltham, Mass.
50139	Allen Bradley: Salt Lake City, Utah
50434	Hewlett-Packard Co.: Palo Alto, Calif.
52090	Rowan Controller Co.: Westminster, Md.
53983	Sanborn Company: Waltham, Mass.
54294	Shallcross Mfg. Co.: Selma, N.C.
55026	Simpson Electric Co.: Chicago, Ill.
55933	Sonotone Corp.: Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.: So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc. Tonawanda, N.Y.
56289	Sprague Electric Co.: North Adams, Mass.
59446	Telex Corp.: Tulsa, Okla.
59730	Thomas & Betts Co.: Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.: Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.: Pittsburgh, Pa.
62119	Universal Electric Co.: Owosso, Mich.
63743	Ward-Leonard Electric Co.: Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.: New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark: Newark, N.J.
66295	Wittek Mfg. Co.: Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.: St. Paul, Minn.
70109	Adams and Westlake: Elkhart, Ind.
70276	Allen Mfg. Co.: Hartford, Conn.
70309	Allied Control: New York, N.Y.
70318	Allmetal Screw Product Co., Inc.: Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp. Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.: Chicago, Ill.
70563	Amperite Co., Inc.: Union City, N.J.
70674	ADC Products Inc.: Minneapolis, Minn.
70903	Belden Mfg. Co.: Chicago, Ill.
70998	Bird Electronic Corp.: Cleveland, Ohio
71002	Birnbach Radio Co.: New York, N.Y.
71034	Bliley Electric Co., Inc.: Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas: Quincy, Mass.
71218	Bud Radio, Inc.: Willoughby, Ohio.
71279	Cambridge Thermionics Corp.: Cambridge, Mass.
71286	Camloc Fastener Corp.: Paramus, N.J.
71313	Cardwell Condenser Corp.: Lindenhurst, L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.: St. Louis, Mo.
71436	Chicago Condenser Corp.: Chicago, Ill.
71447	Calif. Spring Co., Inc.: Pico-Rivera, Calif.
71450	CTS Corp.: Elkhart, Ind.
71468	ITT Cannon Electric Inc.: Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.: Burbank, Calif:
71482	C. P. Glare & Co.: Chicago, Ill.
71590	Centralab Div. of Globe Union Inc. Milwaukee, Wis.
71616	Commercial Plastics Co.: Chicago, Ill.
71700	Cornish Wire Co., The: New York, N.Y.
71707	Coto Coil Co., Inc.: Providence, R.I.
71744	Chicago Miniature Lamp Works: Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.: Chicago, Ill.
71984	Dow Corning Corp.: Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.: Willimantic, Conn.
72619	Dialight Corp.: Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.: Keasby, N.J.
72699	General Instrument Corp., Cap. Div. Newark, N.J.
72765	Drake Mfg. Co.: Harwood Heights, Ill.
72825	Hugh H. Eby Inc.: Philadelphia, Pa.
72928	Gudeman Co.: Chicago, Ill.
72962	Elastic Stop Nut Corp.: Union,N.J.
72964	Robert M. Hadley Co.: Los Angeles, Calif.
72982	Erie Technological Products, Inc.: Erie, Pa.
73061	Hansen Mfg. Co., Inc.: Princeton, Ind.
73076	H. M. Harper Co.: Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.: Fullerton, Calif.
73293	Hughes Products Division of Hughes Aricraft Co.: Newport Beach, Calif.
73445	Amperex Elect. Co.: Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.: New Haven, Conn.
73559	Carling Electric, Inc.: Hartford, Conn.
73586	Circle F. Mfg. Co.: Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.: Philadelphia, Pa.
73734	Federal Screw Products Inc.: Chicago, Ill.
73743	Fischer Special Mfg. Co.: Cincinnati, Ohio
73793	General Industries Co., The: Elyria, Ohio
73846	Goshen Stamping & Tool Co.: Goshen, Ind.
73899	JFD Electronics Corp.: Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.: San Jose, Calif.
73957	Groov-Pin Corp.: Ridgefield, N.J.
74276	Signalite Inc.: Nepture, N.J.
74455	J. H. Winns, and Sons: Winchester, Mass.
74861	Industrial Condenser Corp.: Chicago, Ill.
74868	R. F. Products Division of Amphenol-Borg Electronics Corp.: Danbury, Conn.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
74970	E. F. Johnson Co.: Waseca, Minn.
75042	International Resistance Co.: Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.: St. Marys, Pa.
75378	CTS Knights Inc.: Sandwich, Ill.
75382	Kulka Electric Corporation: Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.: Chicago, Ill.
75915	Littlefuse, Inc.: Des Plaines, Ill.
76005	Lord Mfg. Co.: Erie, Pa.
76210	C. W. Marwedel: San Francisco, Calif.
76433	General Instrument Corp., Micamold Division: Newark, N.J.
76487	James Millen Mfg. Co., Inc.: Malden, Mass.
76493	J. W. Miller Co.: Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.: San Leandro, Calif.
76545	Mueller Electric Co.: Cleveland, Ohio
76703	National Union: Newark, N.J.
76854	Oak Manufacturing Co.: Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.: N. Hollywood, Calif.
77075	Pacific Metals Co.: San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.: South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.: Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.: Princeton, Ind.
77630	TRW Electronic Components Div.: Camden, N.J.
77638	General Instrument Corp., Rectifier Div.: Brooklyn, N.Y.
77764	Resistance Products Co.: Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.: Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works: Elgin, Ill.
78277	Sigma: S. Braintree, Mass.
78283	Signal Indicator Corp.: New York, N.Y.
78290	Struthers–Dunn Inc.: Pitman, N.J.
78424	Speciality Leather Prod. Co.: Newark, N.J.
78452	Thompson-Bremer & Co.: Chicago, Ill.
78471	Tilley Mfg. Co.: San Francisco, Calif.
78488	Stackpole Carbon Co.: St. Marys, Pa.
78493	Standard Thomson Corp.: Waltham, Mass.
78553	Tinnerman Products, Inc.: Cleveland, Ohio
78790	Transformer Engineers: San Gabriel, Calif.
78947	Ucinite Co.: Newtonville, Mass.
79136	Waldes Kohinoor Inc.: Long Island City, N.Y.
79142	Veeder Root, Inc.: Hartford, Conn.
79251	Wenco Mfg. Co.: Chicago, Ill.
79727	Continental-Wirt Electronics Corp.: Philadelphia, Pa.
79963	Zierick Mfg. Corp.: New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.: Morristown, N.J.
80120	Schnitzer Alloy Products Co.: Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards: Washington, D.C.
80207	Unimax Switch, Div. Maxon Electronics Corp.: Wallingford, Conn.
80223	United Transformer Corp.: New York, N.Y.
80248	Oxford Electric Corp.: Chicago, Ill.
80294	Bourns Inc.: Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.: Columbus, Ohio
80486	All Star Products Inc.: Defiance, Ohio
80509	Avery Label Co.: Monrovia, California
80583	Hammerlund Co., Inc.: Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.: Boston, Mass.
80813	Dimco Gray Co.: Dayton, Ohio
81030	International Instruments Inc.: Orange, Conn.
81073	Grayhill Co.: LaGrange, Ill.
81095	Triad Transformer Corp.: Venice, Calif.
81312	Winchester Elec, Div. Litton Ind., Inc.: Oakville, Conn.
81349	Military Specification
81483	International Rectifier Corp.: El Segundo, Calif.
81541	Airpax Electronics, Inc.: Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.: Watertown, Mass.
82042	Carter Precision Electric Co.: Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.: Hoboken, N.J.
82116	Electric Regulator Corp.: Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.: DuBois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.: Paramus, N.J.
82209	Maguire Industries, Inc.: Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division: Emporium, Pa.
82376	Astron Corp.: East Newark, Harrison, N.J.
82389	Switchcraft, Inc.: Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products: Attleboro, Mass.
82768	Phillips-Advance Control Co.: Joliet, Ill.
82866	Research Products Corp.: Madison, Wis.
82877	Rotron Mfg. Co., Inc.: Woodstock, N.Y.
82893	Vector Electronic Co.: Glendale, Calif.
83014	Hartwell Corp.: Los Angeles, Calif.
83058	Carr Fastener Co.: Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.: Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.: Darlington, S.C.
83148	ITT Wire and Cable Div.: Los Angeles, Calif.
83186	Victory Eng. Corp.: Springfield, N.J.
83298	Bendix Corp., Red Bank Div.: Red Bank, N.J.
83315	Hubbell Corp.: Mundelein, Ill.
83324	Rosan Inc.: Newport Beach, Calif.
83330	Smith, Herman H., Inc.: Brooklyn, N.Y.
83332	Tech Labs: Palisade's Park, N.J.
83385	Central Screw Co.: Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.: Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.: Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.: New York, N.Y.
83777	Model Eng. and Mfg., Inc.: Huntington, Ind.
83821	Loyd Scruggs Co.: Festus, Mo.
83942	Aeronautical Inst. & Radio Co.: Lodi, N.J.
84171	Arco Electronics Inc.: Great Neck, N.Y.
84396	A. J. Glesener Co., Inc.: San Francisco, Calif.
84411	TRW Capacitor Div.: Ogallala, Neb.
84970	Sarkes Tarzian, Inc.: Bloomington, Ind.
85454	Boonton Molding Company: Boonton, N.J.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
85471	A. B. Boyd Co.: San Francisco, Calif.
85474	R. M. Bracamonte & Co.: San Francisco, Calif.
85660	Koiled Kords, Inc. : Hamden, Conn
85911	Seamless Rubber Co.: Chicago, Ill.
86174	Fafnir Bearing Co.: Los Angeles, Calif.
86197	Cilfton Precision Products Co., Inc.: Clifton Heights, Pa.
86579	Precision Rubber Products Corp.: Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.: Harrison, N.J.
86928	Seastrom Mfg. Co.: Glendale, Calif.
87034	Marco Industries: Anaheim, Calif.
87216	Philco Corporation (Lansdale Division): Lansdale, Pa.
87473	Western Fibrous Glass Products Co.: San Francisco, Calif.
87664	Van Waters & Rogers Inc.: San Francisco, Calif.
87930	Tower Mfg. Corp.: Providence, R.I.
88140	Cutler-Hammer, Inc.: Lincoln, Ill.
88220	Gould-National Batteries, Inc.: St. Paul, Minn.
88698	General Mills, Inc.: Buffalo, N.Y.
89231	Graybar Electric Co.: Oakland, Calif.
89473	G. E. Distributing Corp.: Schenectady, N.Y.
89665	United Transformer Co.: Chicago, Ill.
90030	United Shoe Machinery Corp.: Beverly, Mass.
90179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.: Passaic, N.J.
90970	Bearing Engineering Co.: San Francisco, Calif.
91146	ITT Cannon Elect., Inc., Salen Div.: Salem, Mass.
91260	Connor Spring Mfg. Co.: San Francisco, Calif.
91345	Miller Dial & Nameplate Co.: El Monte, Calif.
91418	Radio Materials Co.: Chicago, Ill.
91506	Augat Inc.: Attleboro, Mass.
91637	Dale Electronics, Inc.: Columbua, Nebr.
91662	Elco Corp.: Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.: Wakefield, Mass.
91827	K. F. Development Co.: Redwood City, Calif.
91886	Malco Mfg. Co., Inc.: Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.: Freeport, Ill.
91961	Nahm-Bros. Spring Co.: Oakland, Calif.
92180	Tru-Connector Corp.: Peabody, Mass.
92367	Elgeet Optical Co. Inc.: Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.: Tarrytown, N.Y.
92702	IMC Magnetics Corp.: Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.: Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.: Woburn, Mass.
93369	Robbins & Myers Inc.: Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.: Mansfield, Ohio
93459	Weinschel Engr. Co., Inc.: Gaithersburg, Md.
93632	Waters Mfg. Co.: Culver City, Calif.
93929	G. V. Controls: Livingston, N.J.
94137	General Cable Corp.: Bayonne, N.J.
94142	Phelps Dodge: Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations: Quincy, Mass.
94148	Scientific Electronics Products, Inc.: Loveland, Colo.
94145	Wagner Elect. Corp., Tung-Sol Div.: Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.: East Paterson, N.J.
94222	South Chester Corp.: Chester, Pa.
94330	Wire Cloth Products, Inc.: Bellwood, Ill.
94375	Automatic Metal Products Co.: Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.: Worcester, Mass.
94696	Magnecraft Electric Co.: Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.: Boston, Mass.
95236	Allies Products Corp.: Dania, Fla.
95238	Continental Connector Corp.: Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.: Long Island, N.Y.
95265	National Coil Co.: Sheridan, Wyo.
95275	Vitramon, Inc.: Bridgeport, Conn.
95348	Gordos Corp.: Bloomfield, N.J.
95354	Methode Mfg. Co.: Rolling Meadows, Ill.
95566	Arnold Engineering Co.: Marengo, Ill.
95712	Dage Electric Co., Inc.: Franklin Ind.
95984	Siemon Mfg. Co.: Wayne, Ill.
95987	Weckesser Co.: Chicago, Ill.
96067	Microwave Assoc., West Inc.: Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.: Olean, N.Y.
96156	Thordarson-Meissner Inc.: Mt. Carmel, Ill.
96296	Solar Manufacturing Co.: Los Angeles, Calif.
96306	Microswitch, Div. of Minn.–Honeywell: Freeport, Ill.
96330	Carlton Screw Co.: Chicago, Ill.
96341	Microwave Associates, Inc.: Burlington, Mass.
96501	Excel Transformer Co.: Oakland, Calif.
96733	San Fernando Elect. Mfg. Co.: San Fernando, Calif.
96881	Thomson Ind. Inc.: Long Is., N.Y.
97464	Industrial Retaining Ring Co.: Irvington, N.J.
97539	Automatic & Precision Mfg.: Englewood, N.J.
97979	Reon Resistor Corp.: Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.: New Rochelle, N.Y.
98144	R-Tronics, Inc.: Jamaica, N.Y.
98159	Rubber Teck, Inc.: Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.: Pasadena, Calif.
98278	Microdot, Inc.: So. Pasadena, Calif.
98291	Sealectro Corp.: Mamaroneck, N.Y.
98376	Zero Mfg. Co.: Burbank, Calif.
98410	Etc. Inc.: Cleveland, Ohio
98731	General Mills Inc., Electronics Div. Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.: Palo Alto, Calif.
98821	North Hills Electronics, Inc.: Glen Cove, N.Y.
98978	International Electronic Research Corp.: Burbank, Calif.
99109	Columbia Technical Corp.: New York, N.Y.
99313	Varian Associates: Palo Alto, Calif.
99378	Atlee Corp.: Winchester, Mass.
99515	Marshall Ind., Capacitor Div.: Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America: El Segundo, Calif.
99800	Delevan Electronics Corp.: East Aurora, N.Y.
99848	Wilco Corporation: Indianapolis, Ind.
99928	Branson Corp.: Whippany, N.J.
99934	Renbrandt, Inc.: Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.: El Monte, Calif.
99957	Technology Instrument Corp. of Calif.: Newbury Park, Calif.

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